10/518430

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In the Claims:

Please amend the claims attached to the International Preliminary Report On Patentability as follows:

1. (currently amended) A method to locate a fault from one end of a section of a power line ~~(A-B)~~ by means of measurements of current, voltage and angles between the phases at a first ~~(A)~~ end of said section, the method comprising:

~~characterised by~~

- calculating symmetrical components of currents for said current and voltage measurement at said first end ~~(A)~~,

- calculating a value of impedance for an extra link ~~(45, 55)~~ between the terminals ~~(A, B)~~ with the impedance for the positive sequence equal to:

$(\underline{Z}_{1LB\&AB} = \frac{\underline{Z}_{1LB}\underline{Z}_{1AB}}{\underline{Z}_{1LB} + \underline{Z}_{1AB}})$ where:

$\underline{Z}_{1AB}$ = impedance for the positive sequence of the extra link,

$\underline{Z}_{1LA}$ = positive-sequence impedance of the healthy line,

- determining a compensation for the shunt capacitance with the aid of an equation ~~(22)~~ of the form:

$B_2^{comp\_1}(d_{comp\_1})^2 + B_1^{comp\_1}d_{comp\_1} + B_0^{comp\_1} = 0$ where:

$$B_2^{comp\_1} = A_{2\_Re}^{comp\_1}A_{00\_Im}^{comp\_1} - A_{2\_Im}^{comp\_1}A_{00\_Re}^{comp\_1}$$

$$B_1^{comp\_1} = A_{1\_Re}^{comp\_1}A_{00\_Im}^{comp\_1} - A_{1\_Im}^{comp\_1}A_{00\_Re}^{comp\_1}$$

$$B_0^{comp\_1} = A_{0\_Re}^{comp\_1} A_{00\_Im}^{comp\_1} - A_{0\_Im}^{comp\_1} A_{00\_Re}^{comp\_1}$$

- determining the zero-sequence current from the healthy line of a section of parallel power lines,

- calculating a distance to a ~~falt~~ fault for the parallel line section,

- calculating the distance ~~(d)~~ to the fault ~~(F)~~ from said first end ~~(2)~~ using a quadratic equation ~~(26)~~ of the form:

$B_2 d^2 + B_1 d + B_0 = 0$ where:

$$B_2 = A_{2\_Re} A_{00\_Im} - A_{2\_Im} A_{00\_Re}$$

$$B_1 = A_{1\_Re} A_{00\_Im} - A_{1\_Im} A_{00\_Re}$$

$$B_0 = A_{0\_Re} A_{00\_Im} - A_{0\_Im} A_{00\_Re}\cancel{.}$$

2. (currently amended) ~~A~~ The method according to claim 1, ~~characterised by calculating~~ wherein the distance ~~(d)~~ to the fault is calculated using an equation of the form:

$$\underline{K}_1 \underline{Z}_{1L} d^2 + (\underline{L}_1 \underline{Z}_{1L} - \underline{K}_1 \underline{Z}_{AA\_p}) d - \underline{L}_1 \underline{Z}_{AA\_p} + R_F \underline{M}_1 \frac{(\underline{a}_{F1} \Delta \underline{I}_{AA1} + \underline{a}_{F2} \underline{I}_{AA2})}{\underline{I}_{AA\_p}} = 0 \quad (8)$$

where:

$\underline{Z}_{AA\_p} = \dfrac{\underline{V}_{AA\_p}}{\underline{I}_{AA\_p}}$ – calculated fault loop impedance.

3. (currently amended) ~~A~~ The method according to claim 1, wherein ~~any of claim 1 or 2, characterised by calculating~~ the distance ~~(d)~~ to the fault is calculated using an equation of the form:

$$\underline{A}_2 d^2 + \underline{A}_1 d + \underline{A}_0 + \underline{A}_{00} R_F = 0$$

where:

$$\underline{A}_2 = A_{2\_\mathrm{Re}} + \mathrm{j}A_{2\_\mathrm{Im}} = \underline{K}_1 \underline{Z}_{1LA}$$

$$\underline{A}_1 = A_{1\_\mathrm{Re}} + \mathrm{j}A_{1\_\mathrm{Im}} = \underline{L}_1 \underline{Z}_{1LA} - \underline{K}_1 \underline{Z}_{AA\_\mathrm{p}}$$

$$\underline{A}_0 = A_{0\_\mathrm{Re}} + \mathrm{j}A_{0\_\mathrm{Im}} = -\underline{L}_1 \underline{Z}_{AA\_\mathrm{p}}$$

$$A_{00\_\mathrm{Re}} + \mathrm{j}A_{00\_\mathrm{Im}} = \frac{\underline{M}_1(\underline{a}_{F1} \Delta \underline{I}_{AA1} + \underline{a}_{F2} \underline{I}_{AA2})}{\underline{I}_{AA\_\mathrm{p}}}$$

$$\underline{Z}_{AA\_\mathrm{p}} = \frac{\underline{V}_{AA\_\mathrm{p}}}{\underline{I}_{AA\_\mathrm{p}}} = \text{calculated fault loop impedance}$$

$\underline{K}_1$, $\underline{L}_1$, $\underline{M}_1$ = coefficients gathered in TABLE 3.

4. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising:

- determining source impedance at said first end as a representative value, and
- determining a value for source impedance at said second end as a representative value.

5. (currently amended) ~~A~~ The method according ~~to one or more of the preceding claims, characterised by~~ claim 1, further comprising calculating symmetrical components of currents for said current and voltage measured at said first end by:

- inputting instantaneous phase voltages ~~(30a)~~,
- filtering ~~(33a)~~ the values to determine the phasors, and
- calculating ~~(34a)~~ phasors of symmetrical components of voltages.

6. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising calculating symmetrical components of currents for said current and voltage measured at said first end by:

- inputting instantaneous phase currents and instantaneous zero-sequence current from a healthy line ~~(30b)~~,
- filtering ~~(33b)~~ the values to determine the phasors, and
- calculating ~~(34b)~~ phasors of symmetrical components of currents.

7. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising determining a compensation for shunt capacitance by means of an equation of the form:

$$\underline{A}_2^{comp\_1}(d_{comp\_1})^2 + \underline{A}_1^{comp\_1} d_{comp\_1} + \underline{A}_0^{comp\_1} + \underline{A}_{00}^{comp\_1} R_F = 0 \qquad (21a)$$ where:

$$\underline{A}_2^{comp\_1} = A_{2\_\mathrm{Re}}^{comp\_1} + \mathrm{j}A_{2\_\mathrm{Im}}^{comp\_1} = \underline{K}_1 \underline{Z}_{1L}^{long}$$

$$\underline{A}_1^{comp\_1} = A_{1\_\mathrm{Re}}^{comp\_1} + \mathrm{j}A_{1\_\mathrm{Im}}^{comp\_1} = \underline{L}_1 \underline{Z}_{1L}^{long} - \underline{K}_1 \underline{Z}_{A\_\mathrm{p}}^{comp\_1}$$

$$\underline{A}_0^{comp\_1} = A_{0\_\mathrm{Re}}^{comp\_1} + \mathrm{j}A_{0\_\mathrm{Im}}^{comp\_1} = -\underline{L}_1 \underline{Z}_{A\_p}^{comp\_1}$$

$$\underline{A}_{00}^{comp\_1} = A_{00\_\mathrm{Re}}^{comp\_1} + jA_{00\_\mathrm{Im}}^{comp\_1} = \frac{\underline{M}_1(\underline{a}_{F1}\Delta\underline{I}_{AA1} + \underline{a}_{F2}\underline{I}_{AA2})}{\underline{I}_{A\_\mathrm{p}}^{comp\_1}}$$

$\underline{Z}_{A\_\mathrm{p}}^{comp\_1} = \dfrac{\underline{V}_{A\_\mathrm{p}}}{\underline{I}_{A\_\mathrm{p}}^{comp\_1}}$ – fault loop impedance calculated from:

$\underline{V}_{A\_\mathrm{p}}$ – original (uncompensated) fault loop voltage,

$\underline{I}_{A\_\mathrm{p}}^{comp\_1} = \underline{a}_1 \underline{I}_{A1\_comp\_1} + \underline{a}_2 \underline{I}_{A2\_comp\_1} + \underline{a}_0 \underline{I}_{A0\_comp\_1}$ – fault loop current composed of the positive ~~(12)~~, negative ~~(16)~~ and zero ~~(17)~~ sequence currents obtained after deducing the

respective capacitive currents from the original currents, and

$\underline{K}_1$, $\underline{L}_1$, $\underline{M}_1$ = coefficients gathered in TABLE 3.

8. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising measuring the source impedance $\underline{Z}_{1sA}$ at said first end A.

9. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising:

-measuring the source impedance $\underline{Z}_{1sB}$ at said second end ~~B~~,

-sending a communication of the measured value of source impedance $\underline{Z}_{1sB}$ at said second end ~~B~~ to a fault locator at said first end ~~A~~.

10. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising determining the distance to a single phase to ground fault without measurements from an operating healthy parallel line by means of complex coefficients $\underline{P}_0$ according to a formula of the form:

$$\underline{P}_0 = \frac{\underline{Z}_{0LB} - \underline{Z}_{0m}}{\underline{Z}_{0LA} - \underline{Z}_{0m}}$$

and $\underline{K}_1$, $\underline{L}_1$, $\underline{M}_1$ according to

$$\underline{K}_1 = -\underline{Z}_{1LA}(\underline{Z}_{1sA} + \underline{Z}_{1sB} + \underline{Z}_{1LB})$$

$$\underline{L}_1 = -\underline{K}_1 + \underline{Z}_{1LB}\underline{Z}_{1sB}$$

$$\underline{M}_1 = \underline{Z}_{1LA}\underline{Z}_{1LB} + \underline{Z}_{1LA}(\underline{Z}_{1sA} + \underline{Z}_{1sB}) + \underline{Z}_{1LB}(\underline{Z}_{1sA} + \underline{Z}_{1sB})\cancel{.}$$

11. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising determining the distance to a single phase to ground fault without measurements from switched off and grounded parallel line by means of complex coefficients $\underline{P}_0$ according to

$$\underline{P}_0 = -\frac{\underline{Z}_{0LB}}{\underline{Z}_{0m}}$$

and $\underline{K}_1$, $\underline{L}_1$, $\underline{M}_1$ according to

$$\underline{K}_1 = -\underline{Z}_{1LA}$$

$$\underline{L}_1 = \underline{Z}_{1LA} + \underline{Z}_{1sB}$$

$$\underline{M}_1 = \underline{Z}_{1sA} + \underline{Z}_{1sA} + \underline{Z}_{1LA}\cancel{.}$$

12. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising determining the distance to a single ground fault using a first order formula ~~(27a, b, c)~~ of the form:

$$d = \frac{imag\{\underline{V}_{AA\_p}[3(\underline{I}_{AA0} - \underline{P}_0\underline{I}_{AB0})]^*\}}{imag\{(\underline{Z}_{1LA}\underline{I}_{AA\_p})[3(\underline{I}_{AA0} - \underline{P}_0\underline{I}_{AB0})]^*\}}\cancel{.}$$

13. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising determining the distance to a phase-to-phase ground fault using pre-fault measurements and a first order formula ~~(28a, b, c)~~ of the form:

$$d = \frac{imag\{\underline{V}_{AA\_p}[\underline{W}(\underline{I}_{AA0} - \underline{P}_0\underline{I}_{AB0})]^*\}}{imag\{(\underline{Z}_{1LA}\underline{I}_{AA\_p})[\underline{W}(\underline{I}_{AA0} - \underline{P}_0\underline{I}_{AB0})]^*\}}.$$

14. (currently amended) ~~A~~ The method according to ~~one or more of the preceding claims, characterised by~~ claim 1, further comprising determining the distance to a phase-to-phase ground fault avoiding pre-fault measurements and using a first order formula ~~(29a, b, c)~~ of the form:

$$d = \frac{imag[(\underline{V}_a + \underline{V}_b)(\underline{I}_{AA0} - \underline{P}_0\underline{I}_{AB0})^*]}{imag[\underline{Z}_{1LA}(\underline{I}_a + \underline{I}_b + 2\underline{k}_0\underline{I}_{AA0} + 2\underline{k}_{0m}\underline{I}_{AB0})(\underline{I}_{AA0} - \underline{P}_0\underline{I}_{AB0})^*]}.$$

15. (currently amended) A device for locating a fault from one end of a section of a power line ~~(A-B)~~ having means for receiving and storing measurements of current, voltage and angles between the phases at one first end ~~(A)~~, means for receiving and storing a detection of a fault condition between said first and second ends ~~(A, B)~~, ~~characterised by~~ the device comprising:

- means for calculating symmetrical components of currents for said current and voltage measured at said first end ~~(A)~~,
- means for calculating a value of impedance for an extra link ~~(45, 55)~~ between the terminals ~~(A,B)~~,
- means for determining a compensation for shunt capacitance,
- means for determining the zero-sequence current from the healthy line of a section of parallel power lines,
- means for calculating a distance to a fault for the parallel line section,
- means for calculating a distance ~~(d)~~ from said first end ~~(2)~~ to the fault ~~(F)~~.

16. (currently amended) ~~A~~ The device according to claim 15, ~~characterised by~~ further comprising:

- means for determining a value for source impedance at said first end,

- means for determining a value for source impedance at said second end.

17. (currently amended) ~~A~~ The device according to ~~one or more of claim 15 or 16, characterised by~~ claim 15, further comprising:

- means for receiving a measurement of source impedance at said first end ~~A~~.

18. (currently amended) ~~A~~ The device according to ~~one or more of claims 15-17, characterised by~~ claim 15, further comprising:

- means for receiving a measurement of source impedance made at said second end ~~B~~.

19. (currently amended) ~~A~~ The device according to ~~one or more of claims 15-17, characterised by~~ claim 15, further comprising means to receive a measured value ~~(9)~~ for remote source impedance at said second end ~~(B)~~ communicated by means of a communication channel ~~(60)~~.

20. (currently amended) Use of a fault locator device according to ~~any of claims 15-19~~ claim 15, by a human operator to supervise a function in an electrical power system.

21. (currently amended) Use of a fault locator device according to ~~any of claims 15-20~~

claim 15, by means of a process running on one or more computers to supervise and/or control a function in an electrical power system.

22. (currently amended) Use of a fault locator device according to ~~any of claims 15-21~~ claim 15, to locate a distance to a fault in a power transmission or distribution system.

23. (currently amended) Use of a device according to ~~any of claims 15-22~~ claim 15, for locating a fault on parallel power lines.

24. (currently amended) A computer program comprising computer code means and/or software code portions for making a computer or processor perform any of the steps of ~~claims 1-14~~ claim 1.

25. (currently amended) ~~A~~ The computer program product according to claim 24 comprised on one or more computer readable media.